# TO ENSURE GLOBAL PEACE

## *May 1 all-hands meeting launches new era at Sandia*


SANDIA LABS DIRECTOR STEVE YOUNGER, at right, is joined on stage in the Steve Schiff Auditorium by Deputy Labs Director Dave Douglass (closest to Steve), and eight Associate Labs Directors during a May 1 all-hands meeting. California Div. 8000 ALD Dori Ellis joined the session via a video link from Livermore. For more about the all-hands and comments by Steve, the ALDs, and Senior Directors, see the stories on **pages 4-5.** (Photo by Randy Montoya)

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# Brain-inspired computing

## *Work hastens arrival of synaptic microelectronic devices*

By Neal Singer

A battery-like device that takes the place of a transistor seems like a backward technological leap.

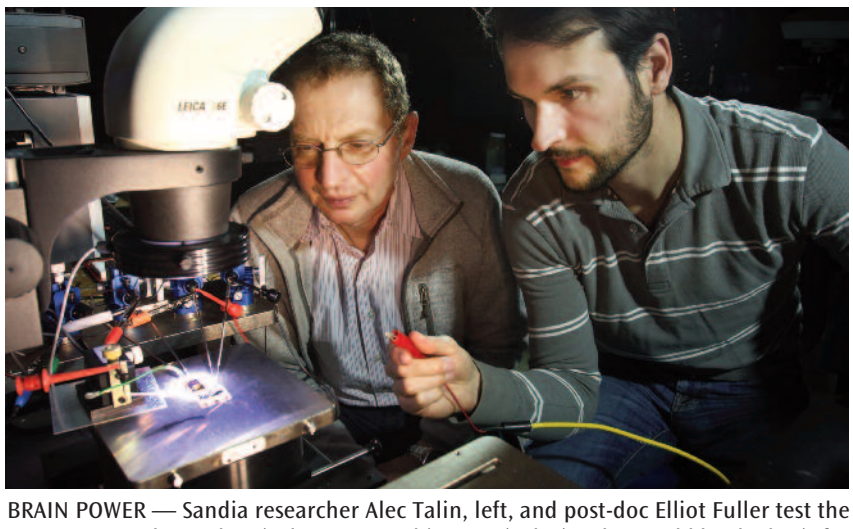
But Sandia researchers, in collaboration with Stanford University, have demonstrated what amounts to a low-voltage artificial synapse that moves ions across a thin dielectric to store information, similar to the way a battery stores a charge. The method could be the basis for future three-dimensional computer architectures, including flexible computer circuits that integrate with the human brain.

The device seems to function better than its more familiar cousin, the transistor, under certain conditions in both digital and analog computers. Lighter and cheaper, it consumes less energy and generates less heat than ordinary transistors. And although slower, it appears trainable, so it might be able to store information without the separate memory required by transistor-based devices. In addition, the device is fabricated from organic polymers that render the device more capable of interfacing with living neural tissue.

### Ideal for machine/brain interface

A team led by Alec Talin (8342), developed the ENODe — an electrochemical neuromorphic organic device — in collaboration with Alberto Salleo from Stanford University. (Enodes' Old English definition means "to clear of knots.") Flexible and made from polymers compatible with biological neurons, it is ideal for intimate machine-brain interface. An explanation of the work was recently published in *Nature Materials*.

"The inspiration came from my work in solid state batteries," says Alec. He leads the solid state battery thrust in the DOE-funded Energy Frontier Research Centers' Nanostructures for Electrical Energy Storage-II, in which Sandia participates.



BRAIN POWER — Sandia researcher Alec Talin, left, and post-doc Elliot Fuller test the ENODe — an electrochemical neuromorphic organic device that could be the basis for future 3-D computer architectures, including flexible computer circuits that integrate with the human brain. (Photo by Dino Vournas)

The researchers actually have created two similar synaptic device designs, the organic ENODe device for bio-interfacing, and an inorganic device dubbed LISTA (lithium-ion synaptic transistor for analog computing) to interact with conventional CMOS circuits for brain-inspired computing applications. (LISTA means "smart" in Spanish).

*(Continued on page 6)*

# That's that

When Laboratories Director Steve Younger introduced himself to Sandians at his first all-hands meeting on May 1, he also introduced a new concept for many of us here: the organizational purpose statement.

"I always get confused with mission and vision statements and they're always too long to remember," he said. "My feeling is if you want somebody to remember something keep it under 10 words. But I *am* a big believer in *purpose* statements and the purpose that I wrote for Sandia is 'Sandia develops advanced technologies to ensure global peace.'

"When I wrote this, I got some feedback saying 'ensure global peace' is unrealistic; it's not gonna happen and to say you're going to do it is reaching too far.' My answer to that is that the alternative is unthinkable. I spent 10 years — I have a side career in anthropology — studying the nature of human violence. I became interested in that after the terrible time of Sept. 11 [2001], when I had been in my office as director of DTRA for a whole week. It was not the job I anticipated. . . . I learned from that study that human beings are not intrinsically violent — and I have data to support it, by the way — but our social systems are prone to violence. Our job at Sandia is to provide technologies that make that violence less probable and if it does occur that the national security interests of the United States and of our allies are maintained."

After Steve's all hands, I got interested in the idea of purpose statements and thought I'd do a little research. Sandia, like most large enterprises, has long had mission, vision, and values statements. Isn't a purpose statement simply a mission or vision statement by another name, a distinction without a difference?

Well, no. It so happens that in *Harvard Business Review* a couple of years ago there was an article that spelled out the distinctions between vision, mission, value, and purpose statements. The story, written by Australian business consultant Graham Kenny, was headlined "Your Company's Purpose Is Not Its Vision, Mission, or Values."

Kenny writes, "We hear more and more that organizations must have a compelling 'purpose' — but what does that mean? Aren't there already a host of labels out there that describe organizational direction? Do we need yet another? I think we do."

In his article, Kenny goes on to say, "A vision statement says what the organization wishes to be like in some years' time. It's usually drawn up by senior management in an effort to take the thinking beyond day-to-day activity in a clear, memorable way."

He describes a mission statement as "what business the organization is in (and what it isn't) both now and projecting into the future. Its aim is to provide focus for management and staff."

Values, Kenny continues, "describe the desired culture."

So how does "purpose" differ from all the above, which emphasize how the organization should view and conduct itself, Kenny asks.

A purpose statement, he says, "takes outward focus to a whole new level, not just emphasizing the importance of serving customers or understanding their needs but also putting managers and employees in customers' shoes. It says, 'This is what we're doing for someone else.' And it's motivational, because it connects with the heart as well as the head." Kenny quotes a retired CEO as saying the company's purpose statement is its "philosophical heartbeat."

"If you're crafting a purpose statement," Kenny concludes, "my advice is this: To inspire your staff to do good work for you, find a way to express the organization's impact on the lives of customers, clients, students, patients — whomever you're trying to serve. Make them feel it."

Expressed as it is in simple, concise terms, Sandia's purpose, "We develop advanced technologies to ensure global peace," is something I can feel, something I can embrace.

I've had lots of jobs in a long work career where I would ask myself, "Is this job worthy of me?" It's a juvenile question. As I've grown older, I know now the question is always, regardless of the nature of the job, "Am I worthy of this job?"

That question has never had more meaning for me than it does today.

See you next time.

— Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)


# All eyes on Austin

## Sandia pitched a panel on clean-energy entrepreneurship, and South by Southwest said yes

**By Nancy Salem**

South by Southwest, the 10-day conference and festival in Austin that celebrates the convergence of interactive media, film, and music, is famously hard to get into as a presenter. There are stories of people pitching ideas for conference sessions or panels year after year, only to be turned down again and again by the SXSW selection committee.

This year New Mexico made it into the elite ranks of SXSW presenters, including a panel led by Sandia. "It's a very competitive process to get invited into SXSW, and we were able to sell our idea," says Jackie Kerby Moore, manager of Technology and Economic Development Dept. 1183.

Last fall, Jackie and David Kistin (1183) pitched the idea of a Sandia-organized panel called "How the DOE Fuels Cleantech Innovation" focusing on programs that support entrepreneurs and small businesses. The panel was accepted into SXSW's Interactive Festival, which spotlights emerging technologies and is known as a breeding ground for new ideas. It includes a trade show, speakers, and a startup accelerator.

> ***"For those 10 days, Austin feels like the center of the universe and SXSW is the place to be."***
>
> **— Jackie Kerby Moore, manager of Technology and Economic Development Dept. 1183**

The Sandia panel was part of the Startup Village, bringing together startups, entrepreneurs, investors, and "innovative tastemakers." Speakers included Raymond Weitekamp from Lawrence Berkeley National Laboratory's Cyclotron Road, a cleantech incubator focused on early stage energy technology; Vladimir Mathias, a former Los Alamos National Laboratory researcher and entrepreneur working with Sandia through the Small Business Vouchers Pilot; and Jean Redfield, president and CEO of NextEnergy and an industry mentor to small companies in DOE's Energy I-Corps program. Jackie moderated the panel.

"We wanted to look at new models for increasing national lab/small business interactions," David says. "Each of our speakers represented different programs and unique perspectives that can be helpful for businesses interested in working with the DOE labs."

SXSW kicks off with technology, and the Sandia panel was on the first day. "It turned out very well," Jackie says. "Our focus was on innovation and we were able to share information about exciting new DOE programs."

SXSW hosts people from all over the world. Jackie says that made the festival extremely energizing. "For those 10 days, Austin feels like the center of the universe and SXSW is the place to be," she says.

She and David were part of a delegation from Albuquerque including Mayor Richard J. Berry and Economic Development Director Gary Oppedahl, as well as the New Mexico Tech Council. While there, Jackie and David were able to connect with the University of Texas and the Austin startup community.

Jackie says that prior to SXSW, Sandia participated in the Rise of the Rest Tour, a nationwide effort led by Steve Case, founder of AOL, to support entrepreneurs in emerging startup ecosystems. "We were thrilled to host Steve and his team and introduce them to several Sandia inventors," she says. "Both SXSW and Rise of the Rest are really good examples of Sandia's engagement in national entrepreneurial efforts."

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**Sandia National Laboratories**

Albuquerque, New Mexico 87185-1468
Livermore, California 94550-0969
Tonopah, Nevada • Nevada National Security Site
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Bill Murphy, Editor . . . . . 505/845-0845
Randy Montoya, Photographer . . . . . 505/844-5605
Patti Koning, California site contact . . . . . 925/294-4911
Michael Lanigan, Production . . . . . 505/844-2297

Contributors: Michelle Fleming (Ads, Milepost photos, 844-4902), Neal Singer (845-7078), Stephanie Holinka (284-9227), Darrick Hurst (844-8009), Heather Clark (844-3511), Sue Holmes (844-6362), Nancy Salem (844-2739), Valerie Larkin (284-7879), Lindsey Kibler (844-7988), Tim Deshler (844-2502), Mollie Rappe (844-8220), Kristen Meub (845-7215), Michael Padilla (925-294-2447), Julia Bernstein (925-294-3609), Jim Danneskiold, manager (844-0587)

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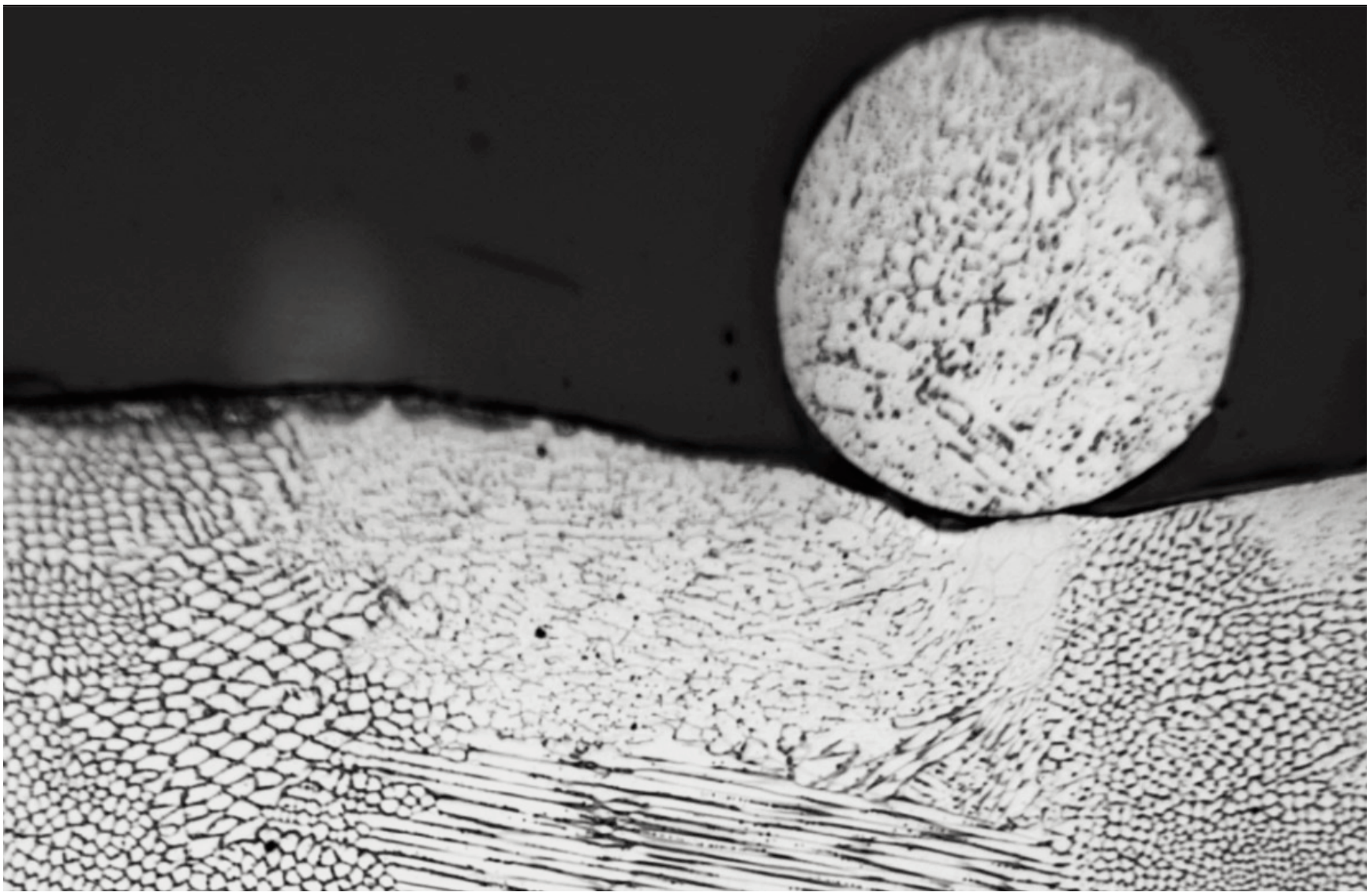


MOONLIGHT BECOMES YOU — The image above is not a grainy moonscape. It is actually a microscope photo from a Sandia team's paper on additive manufacturing, which graces the cover of ASM International's *Journal of Thermal Spray Technology* March 2017 issue. Materials scientist and project PI Nancy Yang (8341) says her team set out to gain insight into the properties of 316L stainless steel, produced through powder-based additive manufacturing processes. The moon-like circle in this photo is a particle of 316L stainless steel powder that was sprayed onto an experimental object but failed to melt into the mass of other steel powder particles. Understanding why some particles melt and others don't is critical to predicting the reliability of the steel being produced, Nancy says. Her team's research is published in the journal, in a paper titled "Process-Structure-Property Relationships for 316L Stainless Steel Fabricated by Additive Manufacturing and Its Implication for Component Engineering."

Sandia Exceptional service in the national interest **CaliforniaNews**

# Sandia hosts Chinese delegation

***By Michael Padilla***

Opening doors for innovation and entrepreneurship opportunities is key for Sandia/California.

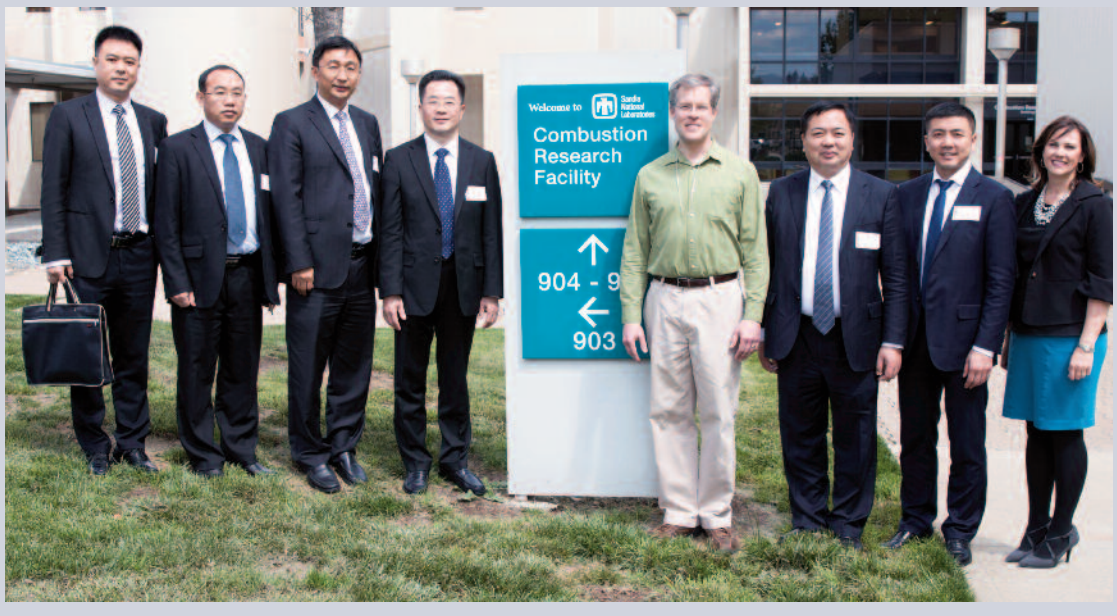
As part of that commitment, it hosted a delegation of municipal leaders from Luzhou, China, on Thursday, April 20. Luzhou, located in the Sichuan Province of China, is known as the wine city of China.

"Partnering with the city of Livermore to provide opportunities to showcase the lab's innovations is important to future technology transfer and small business partnerships," says Stephanie Beasly (8539), who helped spearhead the visit. "The delegation visit is just another example of Sandia's important role in Livermore and the Tri-Valley."

Mark Musculus (8362), who led a tour of Sandia's Combustion Research Facility, says highlighting the work done in the facility is crucial.

"This work supports both US and international energy policy goals of enhancing energy security, protecting the environment, and promoting economic development," Mark says.

The visit to Livermore was led by Livermore Mayor John Marchand. In addition, the delegation visited Lawrence Livermore National Laboratory, i-GATE innovation hub, and Concannon and Wente wineries.




MARK MUSCULUS (8362) led a tour of Sandia's Combustion Research Facility. (Photos by Michael Padilla)


OUTGOING LABS DIRECTOR JILL HRUBY symbolically passes the torch to incomings Labs Director Steve Younger, marking the beginning of a new era for Sandia. As of May 1, National Technology and Engineering Solutions of Sandia, LLC, assumed the DOE/NNSA contract to manage the Laboratories, marking the end of the Lockheed Martin era, which began in 1993.




IN HIS FIRST ALL-HANDS MEETING as Sandia Labs Director, Steve Younger said the Labs' top priority is "delivering outstanding engineering, science, and technology to all of our customers in the most efficient manner possible. And, that's it; there's no No. 2." During his remarks, Steve introduced Sandia's Associate Labs Directors and Senior Directors to members of the workforce.

# Priorities and principles

## Sandia Laboratories Director Steve Younger's first all-hands meeting charts course for future

### *Deputy Labs Director Dave Douglass outlines five immediate initiatives*

**By Bill Murphy • Photos by Randy Montoya**

*"You are the superheroes of technology," Labs Director Steve Younger told an audience of Sandians during his first all hands meeting on May 1 at the Steve Schiff Auditorium and live-streamed to conference rooms and desktops across all the Labs' sites.*

There are industry giants — household names — that do impressive things in the technical arena, Steve said, but as Sandians "you defend the planet and make it possible for millions, if not billions, of people to live safe and productive lives. There is nothing more important than that. There is no more rewarding job than that. So you truly are superheroes of technology." He noted that it takes all Sandians, in both the technical and support organizations, to maintain the nuclear deterrent and do the other vital work of the Laboratories.

Steve said he feels organizational mission and vision statements are too long and are generally forgettable. Instead, he said, "I'm a big believer in purpose statements and the purpose that I wrote for Sandia is, 'Sandia develops advanced technologies to ensure global peace.'"

Jeff Harrell, the manager of the NNSA Sandia Field Office, opened the all-hands by noting that National Technology and Engineering Solutions of Sandia — NTESS — was selected to assume the M&O contract to manage Sandia "because NTESS presented the best value to the government and the highest technical rating."

In his remarks, Steve laid out his priorities for the Laboratories in the operational and programmatic areas.

The top programmatic priority, he said, is: "Delivering outstanding engineering, science, and technology to all of our customers in the most efficient manner possible. And, that's it; There's no No. 2."

In the operational arena, Steve listed several priorities:

- Safety and security
- Collaboration
- Quality
- Efficiency

### Safety, security are personal

After describing the priorities in general terms, Steve said, "Now I want to come back to safety and security. Safety is personal. Your family depends on you. So I'm a big believer in Integrated Safety Management. I use it in my garage as I'm climbing up a ladder. I always think, 'How could the ladder fall? Should I have [my wife] Mary come out and hold the ladder for me? What other things can I do?' Safety is personal, so when you think about doing something, think about your family, think about your significant other, think about your good friend, because they're depending on you to be there."

Security is also personal, Steve said. To make his point, he asked the audience how many knew someone who either is, will be, or was a member of the Armed Forces. Almost everyone in the auditorium indicated they knew someone with a military connection.

"Sandia technologies protect these people," Steve said. "A knowledge of Sandia technologies could put these people at risk. It's a very serious issue. So before you press send on an email that might be questionable, before you leave your office with a safe unlocked, before you start a meeting with classified materials, remember the people you know in uniform because they are relying on you to keep materials secret that need to be kept secret. For them it's a matter of life and death."

Steve outlined several guiding principles that will prevail during his tenure at the Labs.

- Decisions will be made at the lowest appropriate level of the organization;
- We will be data driven;
- We will take a proactive approach to sustaining a diverse and inclusive laboratory culture;
- We are one laboratory with one Labs-wide Laboratory Operating System.

### Moving with urgency

Deputy Labs Director Dave Douglass took the podium to discuss several measures that will be implemented immediately. During the course of the transition period and in meetings with Sandians, he said, "It became clear to us that there were several things that we believe are vital that we start today . . . and move with urgency to act upon. These are not items that we are going to take a year to study and three years to implement."

He listed five immediate initiatives.

- Review and restructure the Environment, Safety, & Health function across the Laboratories;
- Accelerate efforts to streamline and simplify policies and procedures;
- Implement a consistent Program Management approach across the Laboratories;
- Undertake a comprehensive review of the "rates and cost pool approach;" and,
- Implement Honeywell's Performance Management processes.

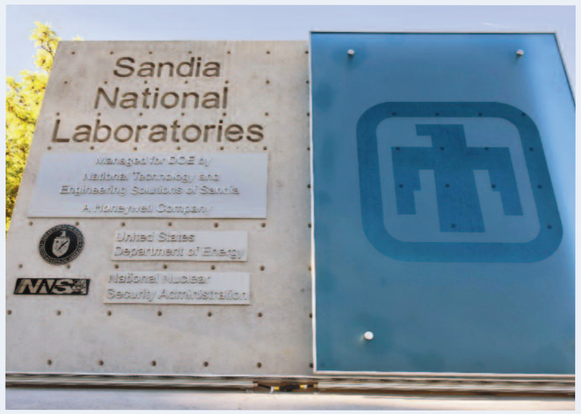
"That's what we're going to start today," Dave said. "Like I say, we are going to move with urgency. I would expect you will begin to hear us providing greater information on what this really means within a month and if we don't do that, you ought to start asking us, 'Where's the beef?' We owe that to you."

Steve concluded his remarks by thanking Sandians for all they have done for the nation. "And now," he said, "let us go forward to continue a proud tradition of 'exceptional service in the national interest.'"

### Gen. Klotz sends greetings

NNSA Sandia Field Officer Manger Jeff Harrell read a message from NNSA Administrator Gen. Frank Klotz, who was not able to join the all-hands in person. "Today culminates a long and careful process to ensure that Sandia remains under outstanding leadership," Klotz wrote, "that its critical missions continue to be performed safely and successfully, that all of its employees have the opportunity to thrive in their work and achieve their full potential, that collaboration with neighboring communities and other research institutions continues to expand, and that the interests of the American taxpayer are well-served. . . . I have every confidence that Dr. Younger and the NTESS team will focus on the Laboratories' many missions with laser-like intensity and just as importantly I have charged them to constantly attend to the welfare and professional development of Sandia's employees, the very lifeblood of this great laboratory."

## Associate Labs Directors, Senior Directors share personal perspectives



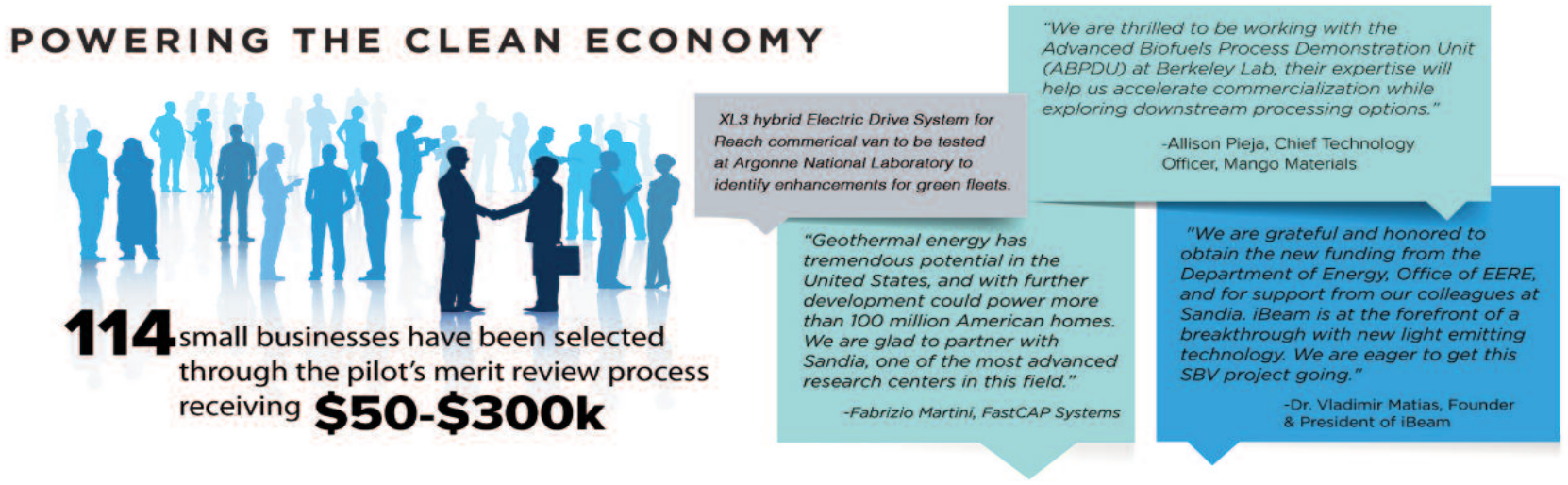

To open the May 1 all-hands meeting, Labs Director Steve Younger introduced Deputy Labs Director Dave Douglass and other members of the new Sandia senior leadership team, the Associate Laboratories Directors and Senior Directors who will leads the Labs' mission and support activities into the future. Here are a few of the comments they made to augment the information published in their official bios.

- **Dave Douglass** said that when the offer came to become part of the NTESS team he had been happily retired and enjoying his grandchildren for several years. He said he had worked with Sandians and known the Labs and been impressed by its work for 35 years. When the offer came to become part of the Sandia team, he said "It was a chance I couldn't refuse."
- **Susan Seestrom,** ALD & Chief Research Officer, Advanced Science and Technology Div. 1000, said, "I am honored to be here as part of the leadership of this extraordinary laboratory. . . I am especially delighted by the interactions I've had with the staff, how open and sharing they have been and how proud they are of our laboratory . . . One of my great passions is education and I am eager to be part of the scene of improving education in Albuquerque."
- **Steve Girrens,** ALD & Chief Engineer for Nuclear Weapons, Nuclear Deterrence Div. 2000, held up his new Sandia business card, noting, "I moved to New Mexico in 1979, so I am a New Mexican now . . . but now, what's even neater is I'm a Sandian."
- **John Clymo,** ALD & Chief Security Officer, Infrastructure Operations Div. 4000, said he was happy to move back to New Mexico "after an absence of 30 years." John noted that he is a gold card member of the Professional Rodeo Cowboys Association, adding "I have performed many times at Tingley Coliseum at the Indian National Finals — my mother is Native American. And I am so happy to be here."
- **Mike Burns,** ALD, National Security Programs Div. 5000, introduced himself as "a second generation national laboratories guy" whose father was a weapons engineer at Los Alamos National Laboratory. He recalled that the first time he visited Kirtland Air Force Base was in 1968, when his father came down to KAFB for a meeting and his mother, who was driving, almost ran over a military police officer. "I will try to do a much better job driving around Kirtland."
- **Doug Bruder,** ALD, Defense Nuclear Nonproliferation Div. 6000, said, "I was born and raised in Michigan, went to school at the University of Michigan, and thought it was a big move for me to go out East — I lived in Virginia for about 35 years. And now I've got to learn to be a Southwesterner and a Sandian, so any help you can provide me I would appreciate that."
- **Dori Ellis,** ALD, Sandia California Div. 8000, said "It's thrilling to be back at Sandia. I retired after 33 years in 2011. I failed retirement. I spent some time across the street at Lawrence Livermore and some time at the University of California getting to know Los Alamos and Lawrence Berkeley, and I can absolutely tell you: There is no place like this laboratory."
- **Mark Sellers,** ALD, Mission Assurance Div. 9000, said, "I am passionate about our missions here and about my organization's role in supporting and enabling those missions to occur in an efficient manner. In my experience, the best way to achieve efficiencies is to anticipate and prevent problems before they occur, put the work in now to prevent the additional work, cost, and heartache later."
- **Scott Aeilts,** ALD, Mission Services Div.10000, noted that having spent most of his career in a company that produced weapon systems and ammunition, "I understand clearly what it means to have weapon-quality products, mil-spec standards." By that measure, he said, Sandia represents "the pinnacle of national defense. . . . I look forward to this journey and can't wait to join you in the legacy you have created and what we can do in the next 10 years.
- **John Myers,** Senior Director, Human Resources & Communications Div. 3000, said, "Wow. It's a delight to be here. The past four months have been crazy busy and I never thought we'd get here, but here we are. After 20 years at Honeywell in the commercial side, to come here in the M&O environment and learn all the acronyms that I've been learning over the past several months, I'm delighted to be here finally on this first day."
- **William Elias,** Senior Director, Legal Div. 11000 and Sandia General Counsel, previously served as General Counsel for the Charles Stark Draper Laboratory in Cambridge, Massachusetts, for 11 years and spent seven years at Argonne National Laboratory in Illinois. "I'm originally from New England," Will said, "and I seem to be getting farther and farther away, but I decided to stop dancing around the edges of the weapons systems and go right to the heart of the whole national security complex, and that's where we are now. . . . One thing that I would emphasize: I do have an ambition for all legal departments that I lead and that is, we are lawyers whose clients are relieved when we walk in the room."


DEPUTY LABS DIRECTOR DAVE DOUGLASS, right, speaks during a news conference on May 1, the day NTESS assumed management of Sandia. At left, Labs Director Steve Younger, who fielded several questions from the local media, looks on.

# In it to win it

## More small, clean-energy businesses will tap into Sandia technical expertise




**By Nancy Salem**

**DOE** *has chosen five more small, clean-energy businesses to work with Sandia to speed the commercialization of next-generation technologies and gain a global competitive advantage for the US.*

"Sandia is excited to bring these small businesses together with our scientists and engineers to tackle challenges and bring new products to the clean-energy marketplace," says Mary Monson, senior manager of Industry Partnerships Dept. 1180. "These partnerships support our energy mission and help the companies and the economy. We're delighted to be a part of this kind of technology transfer."

The Small Business Vouchers pilot, or SBV, was launched in September 2015 letting companies apply for technical help from DOE labs. In March 2016, 33 companies were selected to receive $6.7 million in funding. Seven of them are working with Sandia through vouchers totaling $1.62 million. In August 2016, an additional 43 companies were chosen to receive $8 million in vouchers, five of them with Sandia totaling $983,000.

The announcement of third-round awards was made April 18 at Earth Day Texas in Dallas. The DOE Office of Energy Efficiency and Renewable Energy, or EERE, says eight national labs will receive $7.3 million in vouchers to work with 38 small businesses. The companies selected to work with Sandia are M3 Wave LLC of Salem, Oregon; California Wave Power Technologies LLC of Berkeley; Sentient Science Corp. of Buffalo, New York; Ceramic Tubular Products of Lynchburg, Virginia; and Vacuum Process Engineering Inc. of Sacramento, California. The vouchers total $1.14 million and range from $160,000 to $354,000 each.

"Sandia is working through the SBV pilot with small businesses nationwide, creating jobs and economic vitality," says Jackie Kerby Moore, manager of Technology and Economic Development Dept. 1183. "The potential for widespread national impact from these partnerships is profound and exhilarating."

The pilot, part of EERE's Technology-to-Market program, aims to help small businesses by letting them tap into world-class expertise and tools at the labs to solve critical technology challenges. The pilot will fund projects in the areas of solar, geothermal, wind, water power, fuel cells, advanced manufacturing, bioenergy, buildings, and vehicles. The types of projects include prototyping, materials characterization, high-performance computing, modeling and simulation, scaling to generate customer samples, performance validation, and regulatory compliance.

The eight DOE national laboratories participating in the new round of collaborations are home to some of the most advanced, cutting edge research sites in the world, including Sandia's Scaled Wind Farm Technology, known as SWiFT.

### Lead lab in solar, wind, geothermal

In 2015, DOE chose Sandia as one of five leads in the $20 million pilot to head the sectors of solar energy, wind energy, and geothermal technologies. Other leads are the National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and Pacific Northwest National Laboratory.

The latest companies selected to collaborate with Sandia are working on a wide variety of clean-energy efforts:

• **M3 Wave** will work with Sandia and the National Renewable Energy Laboratory to adapt its deep-water modeling tool, NEXUS, to track differential wave energy by re-creating conditions common on the ocean floor. The goal is to develop a more complex modeling system to predict and increase areas of efficiency up to 25 percent.

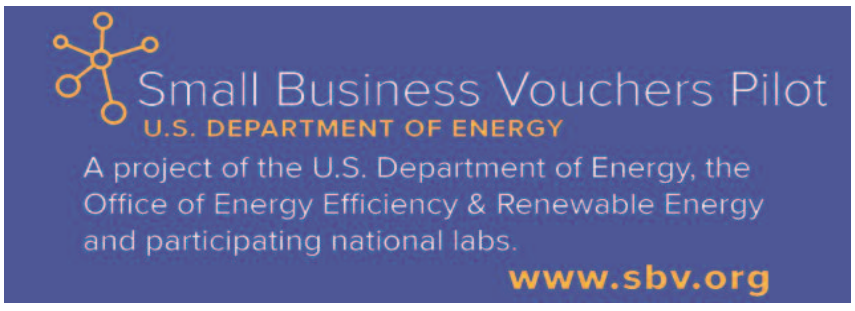
• **California Wave Power** wants to identify, design, and assess decision-making systems to advance wave energy converter technology and do scaled prototype testing of the systems. The project could accelerate adoption and increase the capacity of marine hydrokinetics energy in the US by 70 percent or more.

• **Sentient Science** is developing a technology to predict and extend wind turbine blade life and significantly cut the cost of wind energy.

• **Ceramic Tubular's** high efficiency, low emissivity receiver tubes for concentrating solar power plants could let them operate at higher temperatures and efficiencies and help achieve the DOE SunShot goal of six cents per kilowatt hour cost of electricity by 2020.

•**Vacuum Process Engineering** is working on a process to greatly increase the capacity and reduce the cost of microchannel heat exchangers. The project will use Sandia's 3-D printing to test and evaluate the process.

"Sandia has been a pioneer in clean-energy technologies," says Juan Torres, chief of operations for Sandia's Energy and Climate programs. "We have decades of expertise in solar, wind, water power, and bioenergy, and can help these companies be successful."




# Brain-inspired computing

*"Continuing this exponential trend in energy reduction is one of the greatest challenges in modern computing."*

*(Continued from page 1)*

The LISTA device was built with support from the Grand Challenge Laboratory Directed Research and Development (LDRD) project "Hardware Acceleration of Adaptive Neural Algorithms" (HAANA) led by its principal investigator Conrad James (1728) and by the Thin Film Battery LDRD project, led by Farid El Gabaly (8342).

"The LISTA device is well-suited for implementing the synaptic connections in neural network algorithms," says Conrad. "We need low power consumption and we also need to have the synapses capable of being placed into finely spaced states in order to optimize the algorithm performance. Conventional digital transistor technology has difficulty with these requirements while the LISTA device is very promising on both fronts. We are also examining the ENODe device for brain-inspired computing, given its faster switching speeds."

### Prototype neural networks in hardware

A technical description of the LISTA device work was published in the journal *Advanced Materials*. "One of the thrusts of the HAANA grand challenge is to develop new devices for efficient and accurate neural network performance," Alec says. "ENODe, because of its stability and relative ease of fabrication, is valuable for building prototype neural networks in hardware. We are also very interested in exploring direct connections between our polymer synapse and live biological neurons."

The LISTA and ENODe artificial synapses each act like a battery with an additional input; i.e., with three terminals instead of two. Charge can be moved between the "gate" and "channel" electrode. When the state of charge of the channel changes, so does its electronic conductivity and the current between the source and drain. When no voltage is applied to the gate electrode, the channel conductivity remains constant.

The devices get around the high level of energy needed to switch between states in two-terminal synapse models. An energy barrier that's too low means that mere thermal fluctuations can overcome it, which could produce the undesirable result of a device switching states at random. "If you lower the voltage, it would simply switch back to its earlier state," says Alec.

In ENODe, the barrier that maintains the device state is separate from the one that governs switching. Thus, the device needs a tiny bit of voltage to switch, and yet can retain that induced state for a long time. "Like a battery, it stays charged once you charge it," says Alec.

A system composed of such devices is expected to use far less power than any silicon-based transistor system. The device achieves more than 500 states of conductivity and needs only 0.5 millivolts to switch between adjacent states. However, though requiring on the order of a thousand times less energy than silicon transistors, it still uses about 10,000 times the energy of a biological synapse. But the Sandia synapse can be cut down in size, with a corresponding reduction in energy requirements.

### More than 20 peer-reviewed publications

"Energy per computation has been reduced by a factor greater than one trillion since the first vacuum tube-based computers," says Matt Marinella (5268), device lead on the HAANA project. "However, continuing this exponential trend in energy reduction is one of the greatest challenges in modern computing. We believe these brain-inspired devices are one of the most promising avenues to achieve this goal."

The HAANA project is focused on developing neural-inspired algorithms and hardware architectures for imaging and cybersecurity applications. Now in its third year, HAANA has more than 20 peer-reviewed publications on a range of topics including deep learning, spiking digital architectures, and resistive memory devices. The project's microelectronic hardware thrust, led by Matt, is tasked with designing and fabricating devices that are specifically tuned for neural-inspired algorithms that require time-consuming and power-hungry training with example data.

Polymer fabrication of the ENODe was led by Stanford's Salleo. Testing was done by Alec and by Elliot Fuller (8342), a Sandia postdoc who did much of the fabrication and testing of the Sandia devices. Modelling was handled by Matt and by Sapan Agarwal (8956). Other researchers include Francois Leonard (8342), Robin Jacobs-Gedrim (1768) and Steven Plimpton (1444).

"These are currently only benchtop devices," says Alec. "Polymers are cheap to manufacture, but before we go there, we need to demonstrate arrays capable of implementing brain-inspired algorithms, which is what we are currently working on."

# SANDIA CLASSIFIED ADS

## MISCELLANEOUS

KING-SIZE BED, Sealy Posturepedic; 2 twin long beds, box springs, steel frame, mattress pad, https://albuquerque.craigslist.org/fuo/6097088096.html, $250. Green, 515-7736.

SHOPSMITH MARK 5, w/joiner, $220; lathe tools, 2 sanding discs. Tichenor, 892-9373.

OLD STANFORD YEARBOOKS, 3, for any collectors out there, free. Kepler, 291-3448.

LADDER SYSTEM, Little Giant #10103, wall bracket, telescoping plank, step platform, manual, like new, $200. Sinton, 828-9672.

SISSY BAR, detachable, quick-release, w/backrest pad, for Harley-Davidson Softail Breakout, compatible w/'11 & newer models, brand new condition, $200 firm. Mann, 505-269-7302.

INFANT CRADLE, kid's bed, 2 car seats & more, all excellent & clean condition, low price. Schwarz, 505-323-9006.

POWER TOOLS, Woodtek 10-in. table saw; drill press; Craftsman band saw joiner/planer. Hanson, 298-2120.

BIKE TRAVEL CASE, for Road/Tri/MTB, Ruster Sports Hen House, soft-sided w/padding, used once, $350. Giese, 505-332-8212.

LED TV, Jensen 12-V, 32-in., new, still-in-box, $448 new from Amazon, asking $375. Kercheval, 505-266-5833.

SANYO TV, not flat screen, large, heavy, functioning, far NE Albuquerque, you pick up, free. Penner, 505-856-7190, ask for Julian.

OUTDOOR SPRINKLER CONTROLLER, modular, Rainbird ESP4ME, 120-V, 4 stations, expandable to 22, pigtail cord, manual, $70. Thompson, 505-292-2877.

TREADMILL, many features, seldom used, great condition, $125. Sutton, 505-298-0001.

LATERALS, $150; metal cabinet, $150; chair & ottoman, $150; Tectrix gym stair stepper, $750; like new. Logan, 459-5164, ask for Mia.

FILL DIRT, ~1-2 tons, call for details, bring your own truck, dirt cheap, free. North, 505-514-7878.

CARD TABLE, folding, w/4 chairs, $20; 2 metal lamps & shades, stone base, $50 ea.; punch bowl, $15. Drebing, 293-3335.

POOL TABLE, Brunswick, 8-ft., w/accessories, like new, photos available, you must disassemble & move, paid $3,200, asking $1,000. Garcia, 505-292-5398.

GATE DOOR, wrought iron, white, 6-ft., for patio sliding door. Baca, 301-3760, ask for Daniel.

GRACO ALEXIS SWING, $60; summer infant Lila bassinet, $50; Fisher Price Rock & Play sleeper, $20. Lusk, 505-999-8781.

COMPUTER DESK, w/matching printer table, holds 25-in. monitor, top storage, keyboard tray, drawer, excellent condition, $45. Kelly, 505-306-4365.

MATTRESS TOPPER, memory foam, fits California King bed, $75; car cover for '09 Camry, $50. Jaramillo, 263-2153.

DINING ROOM CHAIRS, 6, Ashely Furniture, black metal, brown baroque fabric seats, good condition, photos available, $165. de la Fe, 610-2700.

MOVING SALE, '09 Toyota Prius; entertainment center; desk; dinette; queen furniture; recliner sofa; coffee/end tables. Zeuge, 509-420-0205.

### How to submit classified ads

**DEADLINE: Friday noon before week of publication unless changed by holiday.**

**Submit by one of these methods:**

- **EMAIL: Michelle Fleming (classads@sandia.gov)**
- **FAX: 844-0645**
- **MAIL: MS 1468 (Dept. 3651)**
- **INTERNAL WEB: On internal web homepage, click on News Center, then on *Lab News* link, and then on the very top of Lab News homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902.**

**Because of space constraints, ads will be printed on a first-come basis.**

### Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

## TRANSPORTATION

'06 HUMMER H3, red, new BFG KO2 tires, tow pkg., 84K miles, excellent condition, reliable, $16,950. Burr, 505-293-2588.

'94 OLDS CUTLASS CIERA, AT, white, recently serviced, new battery, 100K miles, $1,000. Muhlberger, 505-362-8731, text please.

'00 FORD F250 LARIAT, super cab, long bed, new paint, 93K miles, $6,000. Brewer, 505-604-7546.

'06 VOLVO XC90, FWD, seats 7, tan leather, black, recent maintenance, 95.5K miles, good condition, $6,500. Williams, 505-273-0032.

'08 MAZDA MIATA MX-5 GTHT, fully loaded, 1 owner, 44K miles, outstanding condition, $13,000 OBO. Roesch, 899-9145.

'05 HONDA CRV, AWD, mechanically great, minor paint fading, 212K miles, $4,100. Kennicott, 505-259-0826.

'08 HONDA ODYSSEY VAN, white, new tires, excellent mechanical condition, good interior condition, 160K miles, $4,000. Vianco, 275-1635.

## RECREATION

'14 FLAGSTAFF POP-UP TRAVEL TRAILER, 10-ft., sleeps 6, kitchen, toilet, shower, grill, 3K miles. Taylor, 505-660-0798.

'09 5TH WHEEL, 27-ft., original owner, 15,000-Btu AC, large refrigerator, microwave, several upgrades, $13,900. Sanchez, 296-7784.

'16 WINNEBAGO SUNSTAR LX, class A, 3 slides, loaded w/$22,000 in options, 5.5K miles, like new, $95,000. Campbell, 620-5369.

'07 CROSSROADS CRUISER 5TH WHEEL, 27-ft., stored inside, interior like new, 1K highway miles, $15,000. Endres, 505-263-1616, ask for John.

FIXED-GEAR BICYCLE, new, Pure Fix, matte black frame, Babylon gold deep dish wheels, $275. Logothetis, 505-235-0172.

## REAL ESTATE

4-BDR HOME, 4 baths, 2 half baths, 3,565-sq. ft., 5.2-acre lot, Edgewood, https://tinyurl.com/mjecu8m, $400,000. Brenza, 505-281-7767.

3-BDR. HOME, 2 baths, .23 acre, quiet Los Lunas neighborhood, well maintained, updated, views, MLS#887341, $124,900. James, 505-261-1334.

4-BDR. HOME, 2-3/4 baths, 2,700-sq. ft., clean, well maintained, Sandia high school district, $178,000. Mozley, 884-3453.

5-BDR. HOME, 3 baths, 4,280-sq. ft., swimming pool, separate in-law quarters, Four Hills. Ramos, 972-951-0290.

4-BDR. HOME, 2-1/2 baths, 2,972-sq. ft., NW Albuquerque, https://tinyurl.com/mschggg, buy now, realtor's commission is yours, $330,000. Miner, 505-503-7889.

TRIPLEX, two 650-sq. ft. units, 1-bdr., 1 bath, one 900-sq. ft. unit, 2-bdr., 1 bath, new roof, new waterlines, low maintenance, cap rate of 10%, 330 Truman NE, near Lomas & San Mateo, $165,000. Dwyer, 505-249-6935.

## WANTED

LARGE STORAGE BUILD, e.g. 15-30-ft. wide x 15-30-ft. long, Morgan/Tuff Shed-style, w/floor, reasonably priced. Golden, 823-9656.

DALLAS COWBOY TICKETS, 2, home game against Giants, September 10. Molina, 236-8216.

# Five environmental initiatives receive excellence awards

***By Lindsey Kibler***

In keeping with what has become an annual event, Sandia once again has honored members of the workforce for their contributions to environmental stewardship at the Labs.

This year, 43 Sandians were recognized during the Environmental Management System Excellence Awards held April 27 in conjunction with the Labs' Earth Day activities. The awards have been a part of Sandia's Environment, Safety & Health program for more than a decade and serve to demonstrate continual environmental excellence and improvement throughout the Labs.

"This year, we received a broad range of impressive nominations ranging from teams that enhanced our reduce, re-use, recycle principles to labs whose clean-up and waste minimization efforts saved, and will continue to save, hundreds of thousands of dollars, divert more than half a million pounds of waste away from the landfill, save more than 2 million gallons of water a year, and continue to reduce risk," says Environmental Management System Program Coordinator Chris Catechis (0643).

Div. 10000's 100-percent Recycled Content Paper initiative received the **Resource Conservation Award**, which recognizes conservation excellence. The division's FY16 goal was to attain a purchase rate of 50 percent for recycled content paper. The sitewide purchase rate is now at 100 percent — an 18 percent cost savings that translates into a roughly $100,000 per year cost reduction and an annual savings of about $5,600. Award recipients are Charles Atwood (04021), Catherine Benavidez (10248), Donald Devoti (10248), Sam McCord (4144), Michael Nagy (4144), Blake Thies (10248), and Ralph Wrons (4144).

Gilbert Duran (5957) received the **Greenie Award** for removing bare lead from Center 5900 locations. He collected 239 pieces of bare lead bricks, sheets, and miscellaneous pieces, and sent 6,650 pounds to the lead bank. Center 5900 now uses a coated lead to protect against damage to people and the environment. The Greenie Award recognizes individuals for going above and beyond for environmental stewardship outside of their job description.

The **Environmental Protectors Award** recognizes members of the workforce who have reached beyond their jobs to substantially reduce risks posed to environment, safety, and health. This year's award was presented to members from Center 2700 and Dept. 4128 for their Legacy Hazardous Waste Inventory Reduction effort. The team identified and disposed of 2,814 legacy inventory neutron tubes, tube transformer assemblies, and neutron generator subassemblies taking up classified space. The inventory freed up 367 cubic feet of classified storage, eliminated associated Nuclear Enterprise Assurance security risks, and disposed of 137 cubic feet of classified radiological and mixed waste holdings from inventory and 563 curies of associated tritium. In addition, they put in place a process to configure and dispose of units as necessary. The team members are Andrew Aboytes (2725), Kayla Blemel (2722), Harrison Bucy (2732), Curt Dundas (2725), Justin Griffin (2723), Joseph Houck (2734), Justin Kemp (4128), Anthony Leyba (2725), Jason Mays (41281), Steven Nunez (2725), Eileen Rios-Stump (2725), Brenda Sammons (2725), Virginia Steiner (41281), and Epifanio Waquiu (2725).

John DiGregorio (1747) and Michael Olewine (1747) were presented the **Hazardous Waste Eliminators Award** for cutting consumption of a hazardous solvent used in the MESA Fab. Their CMOS7 Process Flow Improvement initiative identified the toxic solvent used extensively in the CMOS7 process to build radiation-hardened application-specific integrated circuits. The solvent was used as cleaning agent in the standard process before adequate inspection tools existed to evaluate the cleaning methods, and it required special handling during its disposal. Using a new inspection tool, the team determined 25 of the 31 clean steps were unnecessary and harmful. The result was 270 gallons less solvent used annually, less energy and water usage, fewer processing steps and fewer audits, an annual cost savings of roughly $100,000, and a yield increase from 60 percent to 70 percent.

Custodial Services was awarded the **Waste Reduction Heroes Award** for its waste elimination efforts. The organization's efforts to manage internal processes included replacing liquid soap with foaming soap, resulting in a reduction of nearly 2.5 million gallons in water use; using recycled-content bin liners, saving nearly $25,000 annually; and reducing paper towel use through composting, setting the stage for a 50-ton reduction in annual waste to the landfill.

Custodial Serves team members are Charlene Argo (48486), David Baca (48486), Belinda Christakis (48486), Roy Cuoco (48485), James Griego (48484), Timothy Harrington (48484), Joshua Konetzni (4848), Eric Lopez (48485), Chris Romero (48486), Sally Romero (48484), Lucy Saiz 48484), Dorothy Sauceda (48486), and Andrew Vigil (48485)

The Tech Area 3 Clean-up Campaign received an honorable mention for creating a long-term plan for a systematic cleanup of eight major sites in the tech area. To date, more than 430,000 pounds of metal have been moved offsite to the recycler. The campaign was developed by Janise Baldo (1533), Thomas Faturos (1533), Charles Roma (4144), and Randall Watkins (1533).

Sam McCord received an honorable mention for his continued commitment to the environment. In addition to being nominated for three awards this year — winning one for resource conservation—Sam received the **Change Agent Award** in the 2017 US Department of Energy Sustainability Awards for "several successful materials-management programs at Sandia." Sandia shares recycling efforts with Kirtland Air Force Base and Sam's programs have been used as examples throughout the US Air Force. He was the only individual to be recognized across the DOE complex.

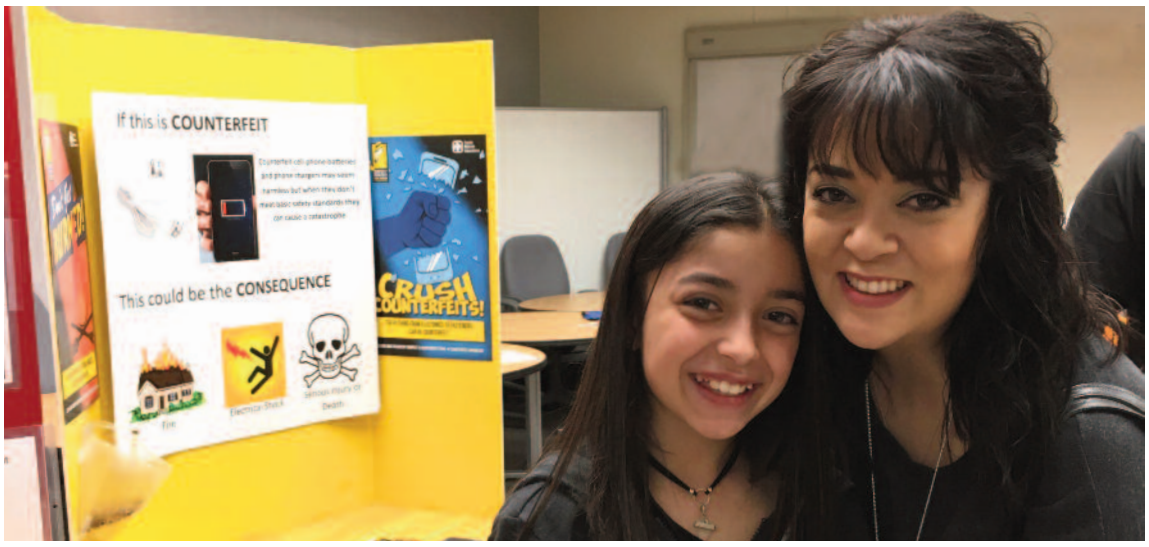
ES&H Director Jaime Moya says environmental management is a quality-based system and a DOE requirement "that is important to Sandia because it helps us manage our environmental risks and continue to be good stewards of the environment" and workforce nominations "show line support and commitment into incorporating environmental considerations and continual improvement into mission work."

# Our first pipeline

## More than 1,600 kids turn out for Take Our Daughters and Sons to Work Day

***Story by Bill Murphy***
***Photos by Roberta Rivera***

Take Our Daughters and Sons to Work Day: Think of it as the Labs' very first pipeline — the first opportunity each year that Sandia has to introduce itself up close and personal to the next generation of scientists, engineers, business and administrative professionals, tradespeople, security officers, and others who collectively make it possible to fulfill Sandia's vital purpose: to develop advanced technologies to ensure global peace.




TALLY LOBATO of Recruiting and Student Programs Dept. 3555 and her daughter pause during a visit to the Div. 1000 Suspect/Counterfeit Items Booth, which aimed to familiarize individuals with the risks of counterfeit consumer products.

This year, more than 1,600 youth in grades 5-12 came to Sandia to see where their parents, aunts, uncles, friends, and neighbors work and find out more about the myriad career opportunities in the nation's premier national security laboratory.

This year, the children, nieces, nephews, neighbors, and friends of all members of the workforce were eligible to participate in the dozens of activities scheduled in labs, offices, shops, auditoriums, and test sites around the Labs. TODSTWD was held in conjunction with Sandia's Earth Day 2017 activities, which included the annual EMS awards presentation (story on page 7).

One attendee's assessment of the day expressed a sentiment shared by almost everyone: "My husband works here, too, and this is the first year our oldest son was eligible to attend. It's a huge employee morale boost to be able to share a part of our work lives with our son. We are so proud of what we do at Sandia and we want our boys to be proud of us as well. I'm so grateful we have this opportunity."

The high winds that rose up early on the morning of April 27 couldn't put a damper on the enthusiasm of attendees or foil the day's activities. Events scheduled for Hardin Field and other outdoor venues were moved indoors and while organizers had to scramble, they made the best of a demanding situation and attendees hardly missed a beat in adjusting their plans for the day.

Perhaps like no other annual activity at the Labs, TODSTWD involves and energizes a broad cross section of Sandians from all levels and all fields: "This is important to all employees," one parent said at the time. "I'm on the business side of the house and my husband is on the technical staff, and we were both equally excited to show our kids where we work."

Other comments from employees echoed the sentiment:

- What am amazing year!
- The activities hosted by our employees were top notch.
- Where else can students be exposed to the unique work we do if not for this special day?
- Many kids are only partially interested in what their parents do until they get to see it first-hand. Suddenly their parent is much more interesting and their curiosity is piqued. That's really the goal — to entice students and get them wondering about how they too can get to do the work they see at Sandia.
- As Sandians, I think we tend to push our kids when it comes to academics, but there is nothing like them being able to actually see first-hand the options that become available to you with a good education.

A YOUNG GUEST dons a virtual reality headset during a visit to a Div. 6000-hosted activity called "Serious Gaming and AR/VR Work at Sandia," which showed how these technologies enhance Sandia's simulation, training, and analysis efforts.

The young visitors each year clearly relish being able to see what Sandia is all about, but is the day really a pipeline for future Sandians? One parent knows so: "Watching some engineering tests in Tech Area 3 two years ago during TODSTWD convinced my son he wanted to go into mechanical engineering."

TODSTWD event coordinator Roberta Rivera says, "This is a win-win-win for students, parents, and Sandia as a whole. The members of the workforce love it, the students love it, and we have seen time and again that exposing young people to what we do really can spark an interest in STEM careers. We outdo ourselves each year and I'm already looking forward to what we can do in 2018."

LAURA MATZEN of Cognitive Sciences and Systems Dept. 1463 introduces young visitors to "Brains in Action," a tour of Sandia's Human Performance Laboratory. Students were able to participate in hands-on demos of technologies used in cognitive science and human factors research.

OUTGOING DIV. 6000 VP JIM CHAVEZ takes in the view from atop the Solar Tower at Sandia's National Solar Thermal Test Facility. With him are his son and another young friend. (Photo courtesy of Jim Chavez)

## SWAN

**Leadership • Empowerment • Mentoring • Collaboration**

INSPIRING THE NEXT GENERATION — Blythe Clark (1819) and Olivia Underwood (1851) of the Sandia Women's Action Network hosted a Women in STEM panel during Take Our Daughters and Sons to Work Day. The panel featured women in STEM careers at Sandia and sought to inspire students in the audience while being honest about obstacles the participants had overcome during their careers.


Photo courtesy of SWAN

Blythe said, "We wanted to showcase the enthusiasm that these women have for their careers in STEM, and share their experiences in celebrating their successes and navigating through challenges along the way. We wanted them to see that it's OK if something seems hard. It's OK to learn from our mistakes and to ask questions. When there's an obstacle in your way, you can work to overcome it."

The participants also talked about their educational and career paths, what influenced them along the way, what they find rewarding about their career, and offered advice for young people interested in pursuing STEM careers. From left to right: Jill Wheeler (2576), Erika Roesler (8863), Amber McBride (8635), Nicole Howie (10727), Aseneth Lopez (6332), and moderator Blythe Clark.